PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference VY/sd031186WO	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/IB2004/000164	International filing date *(day/month/year)* 22-01-2004	Priority date *(day/month/year)* -
International Patent Classification (IPC) or national classification and IPC See Supplemental Box		
Applicant Nokia Corporation et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:

   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 4 sheets, as follows:

      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).

      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))

      _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
20-07-2005	30-03-2006
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer Sara Thulin /OGU Telephone No. +46 8 782 25 00

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Cover sheet

International patent classification (IPC)
H03D 7/14 (2006.01)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/IB2004/000164

Box No. I Basis of the report

1. With regard to the **language**, this report is based on:

☒ the international application in the language in which it was filed

☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of:

- ☐ international search (Rules 12.3(a) and 23.1(b))
- ☐ publication of the international application (Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

☐ the international application as originally filed/furnished

☒ the description:

pages 1-17 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished
pages* _____ as amended (together with any statement) under Article 19
pages* 1-4 received by this Authority on 21-03-2006
pages* _____ received by this Authority on _____

☒ the drawings:

pages 1-5 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing *(specify)*: _____
- ☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing *(specify)*: _____
- ☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/IB2004/000164

Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-9	YES
	Claims		NO
Inventive step (IS)	Claims	1-9	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-9	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Documents cited in the International Search Report:

D1: US 20030129958 A1
D2: EP 0410295 A
D3: KASSIM A K ET AL: "Tail current flicker noise reduction in LC VCOs by complementary switched biasing" ICM 2003
D4: US 4392112 A

The cited documents represent the general state of the art.
The invention defined in new claims 1-9, filed with the letter of 21-03-2006, is not disclosed by any of these documents.
The cited prior art does not give any indication that would lead a person skilled in the art to the claimed mixer circuit, receiver circuit, chip, apparatus and method for using a mixer circuit. Therefore, the claimed invention is not obvious to a person skilled in the art.
Accordingly, the invention defined in claims 1-9 is novel and is considered to involve an inventive step. The invention is industrially applicable.

Claims

1. Mixer circuit (31) comprising:
   - a down-conversion mixing component (33) arranged for down-converting an input radio frequency signal (Irf+,Irf-); and
   - an active mixer load circuit (34) connected to output terminals of said down-conversion mixing component (33), wherein said active mixer load circuit (34) includes an active mixer load (51,T1,T2) and modulating means (S1-S4);
   - wherein said active mixer load includes a first transistor (T1), a second transistor (T2) and an operational amplifier (51), wherein a first output terminal of said down-conversion mixing component (33) is connected to a first input of said operational amplifier (51), wherein a second output terminal of said down-conversion mixing component (33) is connected to a second input of said operational amplifier (51), wherein a reference common mode voltage (VCMREF) is applied to a reference common mode voltage input of said operational amplifier (51), and wherein an output of said operational amplifier (51) is connected in parallel to a respective gate of said first transistor (T1) and said second transistor (T2); and
   - wherein said modulating means (S1-S4) include a plurality of switching elements (S1-S4) arranged for connecting alternately on the one hand said

first output terminal of said down-conversion mixing component (33) via said first transistor (T1) and said second output terminal of said down-conversion mixing component (33) via said second transistor (T2) to ground (Gnd), and on the other hand said first output terminal of said down-conversion mixing component (33) via said second transistor (T2) and said second output terminal of said down-conversion mixing component (33) via said first transistor (T1) to ground (Gnd), for modulating a flicker noise produced by said active mixer load (51,T1,T2) away from the signal band of a signal (Ibb+,Ibb-) output by said down-conversion mixing component (33).

2. Mixer circuit (31) according to one of claims 1, wherein said down-conversion mixing component (33) is adapted to down-convert radio frequency current mode signals.

3. Mixer circuit according to one of claims 1, wherein said down-conversion mixing component is adapted to down-convert radio frequency voltage mode signals.

4. Receiver circuit (10) for receiving radio frequency signals and for providing corresponding down-converted signals, which receiver circuit (10) comprises a mixer circuit (31) according to one of the preceding claims.

5. Receiver circuit (10) according to claim 4, wherein at least said mixing circuit (31) and at least one component (15) of said receiver circuit (10) arranged

for processing digital baseband signals are integrated in a single chip (16).

6. Chip comprising at least a mixer circuit (31) according to one of claims 1 to 3.

7. Chip according to claim 6, wherein said mixer circuit (31) is implemented on said chip with a deep sub-micron semiconductor technology.

8. Apparatus comprising a mixer circuit (31) according to one of claims 1 to 3.

9. Method for use in a mixer circuit (31) comprising a down-conversion mixing component (33) and an active mixer load circuit (34), wherein said active mixer load circuit (34) includes an active mixer load, said active mixer load including a first transistor (T1), a second transistor (T2) and an operational amplifier (51), wherein a first output terminal of said down-conversion mixing component (33) is connected to a first input of said operational amplifier (51), wherein a second output terminal of said down-conversion mixing component (33) is connected to a second input of said operational amplifier (51), wherein a reference common mode voltage (VCMREF) is applied to a reference common mode voltage input of said operational amplifier (51), and wherein an output of said operational amplifier (51) is connected in parallel to a respective gate of said first transistor (T1) and said second transistor (T2), said method comprising:

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- down-converting a received radio frequency signal (Irf+,Irf-) by means of said down-conversion mixing component (33);
- controlling an output voltage of said down-conversion mixing component (33) by means of an active mixer load (51,T1,T2) of said active mixer load circuit (34); and
- modulating a flicker noise produced by said active mixer load (51,T1,T2) away from the signal band of said down-converted radio frequency signal (Ibb+,Ibb-) by connecting alternately on the one hand said first output terminal of said down-conversion mixing component (33) via said first transistor (T1) and said second output terminal of said down-conversion mixing component (33) via said second transistor (T2) to ground (Gnd), and on the other hand said first output terminal of said down-conversion mixing component (33) via said second transistor (T2) and said second output terminal of said down-conversion mixing component (33) via said first transistor (T1) to ground (Gnd).